Influence of Global Change on Regional Air Quality in the Pacific Northwest Region

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Global changes, such as climate, land use, land-cover changes, and the associated biogenic and anthropogenic emission changes, are interrelated factors that can cause significant differences in future air quality. This work addresses the consequences of global change on air quality in the continental US, with a specific focus on the Pacific Northwest region. The approach uses a multi-scale numerical modeling system to simulate both current (1990–1999) and future (2045–2054) air quality conditions over two ten-year periods. The model system is comprised of a global-scale National Center for Atmospheric Research (NCAR)/Department of Energy (DOE) Parallel Climate Model (PCM) and the NCAR Ozone and Related Chemical Tracers version 2 (MOZART2) chemical transport model. These global models provide spatial and temporal varying boundary conditions to regional scale application of the NCAR Mesoscale Model version 5 (MM5) meteorology model and the EPA Community Multiscale Air Quality (CMAQ) regional air quality model to resolve secondary pollutant formation and spatial transport over the continental and regional scales. The global climate model provides climatic conditions following the Intergovernmental Panel on Climate Change (IPCC) A2 "business as usual" scenario. The global chemistry model accounts for intercontinental pollutant transport and chemistry that affect background pollutant conditions into the US. Air quality changes in terms of ozone and pollutant depositions from the CMAQ regional air quality model reflect environmental impacts due to global changes plus changes in regional emissions in the US. Collaboration among Washington State University (WSU), NCAR, and the Forest Service is aimed at providing realistic estimates of current and future emissions for both biogenic sources and biomass burning.

Preliminary model results show worse regional air quality conditions for the future period in terms of higher ambient background volatile organic compounds (VOC), reactive nitrogen, and ozone levels transported into the US. The higher pollutant concentrations increase regions of possible non-attainment and prolong ozone exposure by having higher peak ozone levels and an increased number of pollution episodes per year. In addition, impacts from elevated nitrogen and ozone deposition increase risks of adverse ecological effects in the future. These results provide a basis for investigation of future control strategies to mitigate the impact of global change.

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